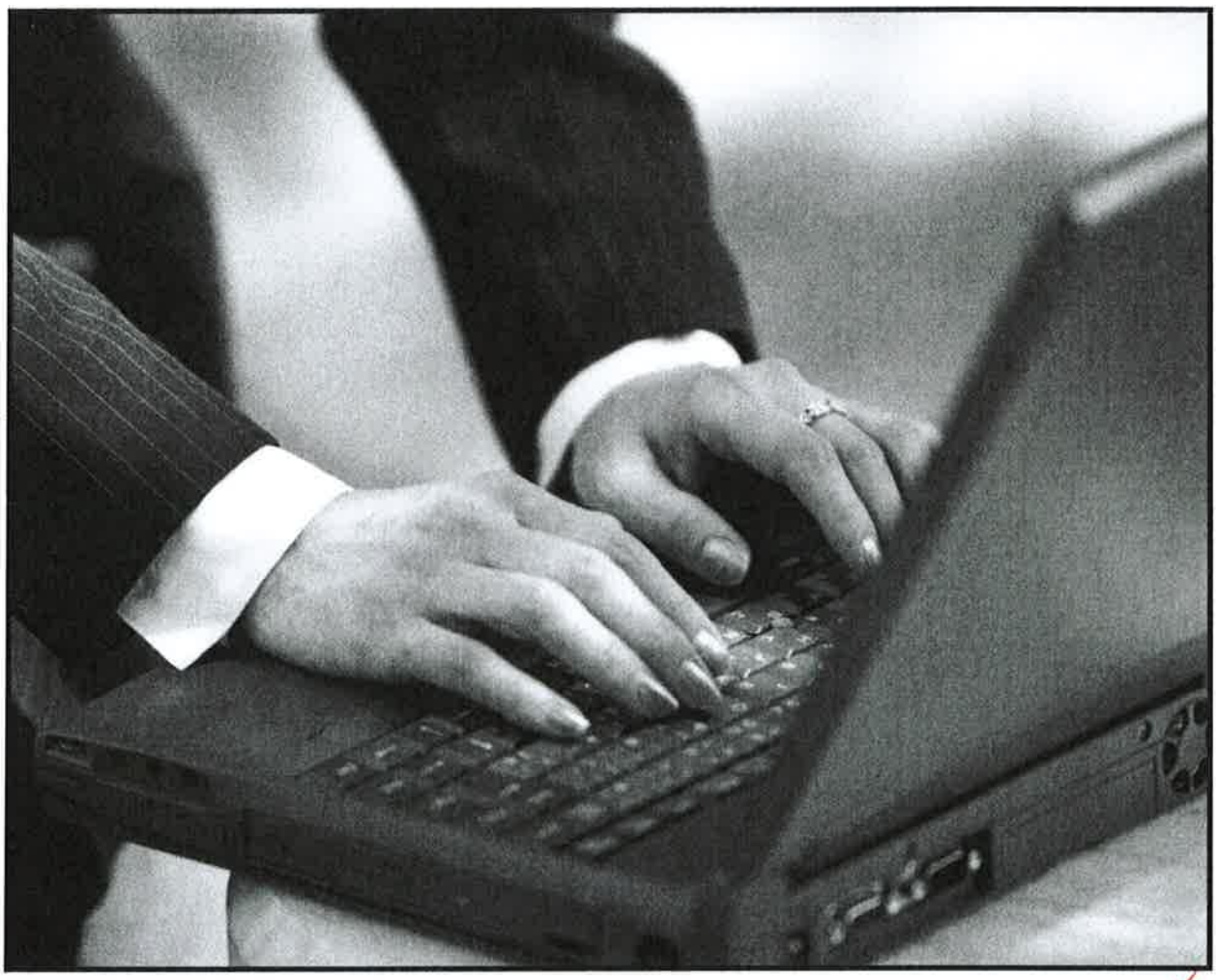
INNOVATIVE MOBILE LEARNING

Techniques and Technologies



HOKYOUNG RYU & DAVID PARSONS

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Hokyoung Ryu and David Parsons (Editors)
Auckland, New Zealand
June 2008

articles, scholarly journals and conferences, to offer one possible source of reading guidance on mobile learning research. With this list, the editors seek to serve both academics and practitioners who want to find out the basic details of mobile learning or disseminate their latest findings through the research network. At the end of this volume there is also a comprehensive glossary, covering most of the terms that may be new to the reader or that are being used in an unfamiliar way.

TOWARDS A SOLUTION

Mobile learning is a relatively new research area. There is an increasing demand for tools and techniques but perhaps less enthusiasm or support for researchers to have the opportunity to fully articulate the relationships among these tools, techniques and underlying pedagogical theory. Therefore, a comprehensive volume of articles covering current trends, technologies and techniques in mobile learning is necessary. In this sense, we believe that this book will be a timely publication for both academics and practitioners who are interested in the design and development of future learning environments. However, this is of course a collection of readings on related topics, not an extended narrative with a beginning, middle, and end. Readers of the book should not feel constrained by the order of the chapters and the structure of the book. Obviously, we have arranged the material in an order that makes sense to us, trying wherever possible to locate readings that speak to the same or closely related issues, but many different arrangements are possible, and these reinterpretations may suggest other solutions to the future challenges of mobile learning.

Hokyoung Ryu and David Parsons (Editors)
Auckland, New Zealand

INNOVATIVE MOBILE LEARNING

Techniques and Technologies

Academia and industry have only begun to explore the vast capabilities that the emerging field of mobile learning has to enrich education. To help researchers and practitioners drive the realization of the potential benefits of mobile learning technology to the next level, a thorough survey of the state of knowledge in this ascending field is vital.

Innovative Mobile Learning: Techniques and Technologies is the first book to comprehensively set out opportunities presented by mobile learning technologies, collecting incisive research articles from leading international experts. Covering field challenges, practical experiences, and current technological advances, this unique contribution to the current research will benefit academics and students in a variety of education and technology-related disciplines, as well as industry specialists in the field of mobile technology.

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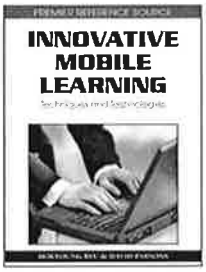

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Chapters

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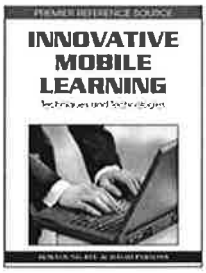

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Preface

The aim of *Innovative Mobile Learning: Techniques and Technologies* is to introduce the reader to the current directions of *mobile learning* (a.k.a. M-learning). More precisely, it is about providing a comprehensive survey of mobile learning research and projects that both academics and educational practitioners may utilize in their work.

It is simply not possible to give a neat definition of *mobile learning*, specifying necessary and sufficient characteristics of all those activities that have ever been called "mobile learning". It is a new phenomenon that has developed through the recent spread of mobile ICT (Information and Communication Technology), both a separate endeavor to traditional pedagogy and a complementary approach to it. Hence, in order to keep the book within manageable bounds, some difficult decisions had to be made about what to include and what to exclude. In making these decisions we were guided by our own experience and the recommendations of our reviewers who contributed significantly to the book's development.

In approaching this novel learning mode, this book argues that a holistic approach for encompassing diverse mobile learning themes is necessary to design new kinds of learning activities with mobile technologies, where there is still a lack of well-defined characteristics and features of mobile learning spaces. It integrates concerns about tools, methods and technologies for mobile learning development with concerns about validating the learning experience that each project produces. This integration is believed to offer a pragmatic solution to critical challenges in both technical design and learning outcomes.

The contribution of this book is thus to bring together a range of approaches to technologies and techniques, presenting them in a common format and at a detailed level. The goal is to provide detailed information about each project, and to make primary sources more accessible.

The rest of this preface introduces the scope of the book and the approach that is employed for its level of description.

THE CHALLENGES

The increasing spread of mobile devices is dramatically affecting people's daily lives. They not only increase the pace and efficiency of everyday life, but also allow more flexibility at business and professional levels.

Arguably, mobile technologies, particularly the increasingly sophisticated mobile phone (blurring the boundaries between communication and computation), combine both ubiquity and utility. This phenomenon has given rise to opportunities to employ mobile technologies more broadly than just as communication tools.

Learning design with mobile technologies has been, to some extent, a successful technological and scientific undertaking, helping to broaden the arenas of the educational sector in ways that no one could have anticipated a decade ago. Of course, we cannot predict its future; however, the progress of the past decade highlights specific current challenges.

To the extent that the success of mobile learning is due to its ambitiously multidisciplinary application, an M-learning text should span its multidisciplinary scientific and technical foundations. Future M-learning systems will only succeed if they can continuously synthesize coherent learning experiences from these foundations. For instance, the Ambient Wood project carried out by Sussex University (U.K) has demonstrated how a mobile and ambient environment can provide a more effective *situated learning* experience. In another learning context, MIT (U.S.A) has developed a *collaborative* M-learning tool to help students understand complex and dynamic epidemic phenomena, simulating them with learners' wearable mobile devices, demonstrating significant advantages over non-mobile e-learning applications. Even Nintendo's DS Lite™ handheld console has been used to provide an enjoyable way to improve Japanese students' *individual* English skills. M-learning is not simply limited to delivering teaching materials onto student's mobile handsets, which the term 'learning' implicitly points out, but also encompasses public information or even commercial information on lifestyle choices and health promotion. Many other domains (e.g., health practitioners) see the advantages of M-learning environments in providing personalized content (e.g., dietary information, quit smoking programs) via the mobile phones that have become so pervasive in recent years. These projects are targeted at

specific objectives but they are also designed to extract the critical success factors that can be used to generalize findings to other M-learning environments. In this way, we can develop a better understanding of how mobile technologies can be used to enhance various user experiences, empower the user with the knowledge and ability to self-manage, and learn how these technologies can improve quality of life across a spectrum of contexts whilst containing costs and stimulating demand for services.

As the technologies that may support M-learning continue to evolve, this field will become increasingly more challenging as new opportunities emerge, and academics and practitioners need to learn from one another's experience. For instance, how to effectively take the user (i.e., learner) into account within emerging M-learning environments has formed a persistent theme in the academic field. In contrast, much of the practitioner's perspective on M-learning applications has been what kind of learning products and content can facilitate the uptake of this new learning environment. To achieve significant outcomes from this research that both deliver technological solutions and enhance the usability and sustainability of the technologies, this book aims to draw together expertise from a range of international academic and industrial contributors.

We also believe that simply being driven by technical initiatives, with a narrow focus only on the quality of mobile technologies, does not capture the potential variety and emergent aspects of mobile learning activities. Practitioners as well as researchers should instead embrace the notion of learning experiences, for a better understanding of the important values that mobile learning can provide. Although this 'experience' or 'learning theme' has been widely discussed, there are still few available empirical, exploratory or large-scale success cases.

OVERVIEW OF THE BOOK

This edited book is intended to discuss the latest mobile learning environments beyond the desktop learning environment, an area of research that is increasingly seeing new developments and techniques in both the academic and commercial fields. It comprises articles from leading researchers and practitioners in the field of mobile learning. One purpose of the book is to disseminate writings about; the challenges and practical experience of the design of mobile learning environments, current developments in mobile learning experiences in both academia and industry, current methods and approaches to mobile learning development, the current economic and social context of M-learning development and empirical research into deployed M-learning environments. More importantly, a key aim of this book is to explore the technical aspects of M-learning development, where we need to systematically take into account learner interactions, learning activities and the completely renewed social and cultural environments that M-learning environments can integrate with and that technologies are now capable of delivering.

Thus, this volume is organized around wide-ranging mobile learning projects, briefly describing each project, and how they address different learning activities with mobile technologies. It then provides a more detailed description, emphasizing what sort of learning outcomes or benefits are produced. Finally, each chapter briefly comments on future research directions, opportunities, or additional ideas offered by the authors of each chapter, and issues that may be important in the next decade.

The chapters are organized in the book along some general dimensions of learning activities: *individual, collaborative and situated.* Before this level of description, some theoretical foundations for learning experiences are firstly described in PART I. This will help the reader to understand the structure of this volume. We then focus on individual learning activities with mobile technologies in PART II, collaborative learning activities in PART III, situated learning activities in PART IV; and finally, PART V addresses challenges in developing mobile learning applications. This organization will hopefully assist the reader in seeing various perspectives of current mobile learning projects, but may be regarded as somewhat idealized. In practice, the applications can differ in many dimensions, and many of them target more than one learning activity, so you may consider that they have been somewhat arbitrarily placed in the book. However, we see the important connecting factor between the chapters is their focus on common themes and arguments.

In detail, we have organized these research efforts into four parts and 17 chapters. A brief description of each of the chapters follows:

PART I provides an overview of theoretical approaches, and describes a way of understanding mobile learning experiences. In Chapter I, Hokyoung Ryu and David Parsons focus on the development of a theoretical framework, setting out three distinct learning spaces that are markedly differently, and considered throughout the book: *individual, collaborative, and situated learning.* This framework provides systematic support for mobile learning experience design, and it is used to analyze three mobile learning environments. Extending this approach, in Chapter II, Patrick Danaher, Raj Gururajan and Abdul Hafeez-Baig deploy mobile learning experiences in conjunction with three key educational principles: *engagement, presence, and flexibility.* Each principle is accompanied by an elicitation of practical strategies that have proved effective in implementing the principles sustainably within particular courses and programs of study, as well as factors that inhibit that implementation.

In PART II, we include four mobile learning projects as practical examples of how individual learners may have mobile learning experiences that lead to specific learning outcomes. Firstly, in Chapter III, Eusebio Scornavacca, Sid Huff, and Stephen Marshall describe the development of a SMS-based classroom interaction system and explore the impact that the TXT-2-LRN system can have on students' learning experience. Their findings indicate that instructors and students perceive a number of benefits from the additional channel of communication in the classroom. With a more sophisticated mobile technology, Christian Kittl, Francika Edegger, and Otto Petrovic (in Chapter IV) demonstrate how mobile game-based learning can be used for an efficient transfer of knowledge in learning processes, revealing its long-term learning outcomes and individual learning efficiency. The empirical results also imply game-based learning leads individual learners to higher energetic activation, more positive emotions, more positive attitudes towards learning content and more efficient knowledge transfer than other instructional formats. In contrast, in Chapter V, Peter Dolittle, Danieele Lusk, C. Noel Byrd, and Gina Mariano explore the use of the iPod™ as an educational platform and report on a study designed to examine individual differences in iPod™ use. It empirically demonstrates an important factor for the success of mobile-based individual learning activities, i.e., working memory capacity (WMC). Finally, Chapter VI by Martin Owen, surveys diverse mobile learning projects, including a simple game-based learning system, a complex multi-role simulation and an environmental tagging and hypermedia project. It explicitly shows how mobile learning projects have been evolving from individual learning support to located and contextual activity-based learning experiences, themes that led us into the remaining sections of the book (PART III and IV).

PART III delivers empirical data and case studies on collaborative learning experiences with mobile

technologies, where the themes in mobile learning are markedly different from traditional e-learning environments. Firstly, Martha Grabowski, Greg Lepak, and George Kulick, working collaboratively between the United States and Poland, empirically examine the impacts of new collaborative technologies (including mobile technologies) on distributed learners. They also introduce a technology-independent framework for taking into account collaborative mobile technologies, relating expected technology impacts to user preferences. The following two chapters (VIII and IX) have been invited from a Pan-European mobile learning research initiative. In Chapter VIII, María Felisa Verdejo, Carlos Celorrio, Emilio Julio Lorenzo, Marta Millán, Sergio Prades, and Javier Vélez present a broad overview of the approach, design and implementation of a collaborative mobile learning infrastructure (i.e., the ENLACE project). Following this, in Chapter IX, Daniel Spikol, Arianit Kurti, and Marcelo Milrad describe the AMULETS (Advanced Mobile and Ubiquitous Learning Environments for Teachers and Students) project. In the last chapter of PART III, Chapter X, Chengjiu Yin, Hiroaki Ogata, and Yoneo Yano provide a further example of the collaborative learning experience, i.e., *Participatory Simulation* that helps both each individual learner and a group of learners to understand sorting algorithms by enacting collaborative processes with mobile devices.

The primary focus of PART IV is how situated learning can be shaped with mobile technologies. Sosuke Miura, Pamela Ravasio, and Masanori Sugimoto, in Chapter XI, present the SketchMap system that supports children's situated learning by creating maps. The goal of the SketchMap system is to investigate whether integrating outdoor and classroom activities and sharing of the children's experiences through the maps can actually promote situated learning. From a somewhat different perspective, Dionisios Dimakopoulos and George Magoulas, in Chapter XII, respond to the ever-increasing need of individuals and organizations for lifelong learning, presenting an approach to designing a mobile application for contextual lifelong learning. It assists learners to access, compose and manage their learning in a range of institutional, informal and work-based settings by keeping them connected with content that is relevant to their studies, and its use is demonstrated in three lifelong learning scenarios. In Chapter XIII, Hokyoung Ryu designs and evaluates a location-aware learning organizer that helps university students to manage their learning activities at campus. Finally in this section, Ana Dzartevska (Chapter XIV) extends this mobile learning experience to professionals who are in need of more contextual understanding of different work procedures.

By way of conclusion, we return to some of the issues and challenges raised at the beginning of this Preface and look at how they may be addressed by the work described in Chapters XV and XVI. Yanjie Song (Chapter XV) reviews and discusses research on applications of handheld devices in education. She classifies these mobile learning applications into six categories based on their functions: educational communication, managing, multimedia access, games and simulations, data collection, and context-aware applications. From a software engineering perspective, Ajax (Asynchronous JavaScript and XML) is explored in Chapter XVI – to increase the mobile Web page's interactivity, speed, functionality, and usability, which seem to be essential qualities in designing mobile learning contents.

In addition to the main body of this book, we also provide a list of recommended readings and resources to help the reader. The final chapter (Chapter XVII) compiles a list of recommended books, articles, scholarly journals and conferences, to offer one possible source of reading guidance on mobile learning research. With this list, the editors seek to serve both academics and practitioners who want to find out the basic details of mobile learning or disseminate their latest findings through the research network. At the end of this volume there is also a comprehensive glossary, covering most of the terms that may be new to the reader or that are being used in an unfamiliar way.

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